Memo

Date: May 22, 2014

To: St. Louis Park WHP Project File (PWSID: 1270000)

From: Justin Blum

Subject: Analysis of the Meadowbrook Golf Course 2 (80212) Production and Pumping Tests, May 1 - 6, 2014, Prairie du Chien - Jordan Aquifer

Test No. 2462

The pumping test performed on Meadowbrook Golf Course 2 (80212) was conducted as described below and summarized in Tables 1 and 2. The data were analyzed using standard methods cited in the references. Analysis graphs are presented in Appendix 1 and are summarized in Table 3. Appendix 2 contains observations, field notes, and any other documentation.

Result Summary

Conceptual model: leaky confined - radial porous media flow

Representative aquifer values:

Transmissivity (T):	15,500	ft^2/day
Aquifer Thickness (b):	254	Feet
Hydraulic Conductivity (k):	58.9	ft/day
Storativity (S):	3.1e-4	
Leakage (L):	--	Feet
Hydraulic Resistance (c):	--	Days

Boundaries: leakage, fracture/conduit flow

Remarks:

Open conduits and/or bedding-plane fractures within the dolostone - sandstone aquifer transmit pumping stresses very quickly over a wide area. Other pumping wells influence water levels in later portions of test, particularly at the distant obwell. Transmissivity is fairly well constrained but there is significant uncertainty in the storativity because of the secondary porosity developed within the aquifer system.

Test Type:

☒ Constant Rate ☐ Variable Rate ☐ Recovery ☐ Step Drawdown ☐ Other (Describe)

☐ Data scanned ☒ Data entered

Table 1. Aquifer Test Information

Test No.	2462
Test Location	Meadowbrook Golf Course Irrigation 2
Well Owner	Minneapolis Park Board
Test Conducted By / For	Traut Well Drilling
Aquifer	Prairie du Chien –Jordan
Confined / Unconfined	Confined
Data Collection Methods	Manual, transducer
Number of Observation Wells	2
Date/Time Monitoring Start	04/18/2014 12:20
Production Test	
Date/Time Start	05/02/2014 09:49
Step Rates (units)	500, 800. 1100, 1400, 1700 gpm
Step Times	10:30, 11:30, 12:31, 13:31, 15:03
Date/Time End	05/02/2014 16:57
Constant Rate Test	
Date/Time Pump off Before Test	05/02/2014 16:57
Date/Time Pumping Start	05/05/2014 09:30:05
Date/Time Recovery Start	05/06/2014 09:35:01
Date/Time Test Finish	05/08/2014 09:10
Flow Rate (units)	1100 gpm

Table 2. Wells Monitored During the Test

Well Name (Unique Well No.)	Radial Distance (feet)	Static Water Levels (feet below measuring point)			Change in Water Level (feet)	Aquifer
		Start	Mid-test	End		
Pumped Well:						
GC 2 (802162)	1	82.0	95.85	89.20	13.85	Prairie du Chien -Jordan
Ob Wells:						
GC 1 (216009)	133	84.60	98.16	87.00	13.56	Jordan-St. Lawrence-Franconia
MH (216067)	2072	81.33	86.98	81.15	5.65	Prairie du Chien -Jordan

Table 3. Analysis Results

Transient Analysis					
Well Name (Unique Well No.)	**Transmissivity, T (ft^2/day)**	**Storage Coefficient, S**	**Analysis Method**	**Time Period Emphasis**	**Plot No. Remarks**
Pumped Well:					
GC 2 (802162)	12,950		Theis	20-400 minutes	A1-1
Ob Wells:					
GC 1 (216009)	12,000	7.2e-5	Theis	20-400 minutes	A1-2
MH (216067)	18,700	2.8e-5	Theis	5-400 minutes	A1-3
GC 1 (216009)	15,600	1.6e-5	Cooper-Jacob	2-400 minutes	A1-6
GC 2 (216009) GC 1 (216009)	**15,470**	**3.1e-4**	Agarwal recovery	2-300	A1-9
Distance Drawdown Analysis	--	--	Theis t/r^2	pumping	A1-4 poor match to Theis curve
	18,700	2.8e-5	Theis t/r^2	Pumping	A1-5 adjusted radial distance

Steady-state Analysis				
Transmissivity, T (ft^2/day)	**Characteristic Leakage, L (feet)**	**Hydraulic Resistance, c (days)**	**Analysis Method**	**Plot No. Remarks**
10,900	13,500	16,800	de Glee	A1-7, low T - unreasonable large L
19,200	47,000	114,800	de Glee	A1-8, reasonable T - absurdly large L

Test Description

Purpose of test: production and constant rate tests were performed by Traut Well to qualify a new irrigation well for Meadowbrook Golf Course, St. Louis Park. The MDH Source Water Protection Unit considered the test of this new well to be a rare opportunity to support wellhead protection efforts of St. Louis Park and adjacent communities.

Test setup: Traut monitored the new irrigation well manually and with a transducer during the tests. Two existing wells were instrumented with transducer-data logger equipment by MDH for water level monitoring, Table 2.

Hydrogeologic setting: the Prairie du Chien-Jordan Aquifer System is extensively used for drinking water and industrial/commercial supply in Hennepin County.

Well construction: the well was blasted and bailed during construction and development to enhance the production capability. Approximately 150 to 200 cubic yards of sand were removed from the borehole, resulting in an effective radius of the pumped well that is substantially larger than the original borehole radius.

Other interfering wells: because of the heavy use of the Prairie du Chien-Jordan Aquifer System, the daily fluctuation in static water levels is large - even in times of low demand. Therefore, a 'static' level is known only within a reasonable range in this aquifer system. The long pre-test monitoring record from the Methodist Hospital well (216067) documents this variability. During the fourteen days prior to the test, the mean water elevation in this

well was 808.9 ft. (MSL). The daily variation in water elevation was +/- 0.78 feet with a standard deviation of 0.39 feet.

Weather conditions: a large precipitation event, 3+ inches of rainfall, occurred during the pre-test monitoring period. This recharge event is reflected in the arithmetic plot of water elevations, Appendix 2. Total April precipitation in the Metro Area was the second highest on record. During the test period the weather was clear and cool.

Data collection, reporting, and analysis:

Data were collected with little problem from wells that were accessible for measurement. Time synchronization between the three data loggers was the most problematical issue. In the field, time of day of the Traut data logger differed from MDH time by more than 8 minutes. However, this was corrected by Traut when the data were transferred from the data logger. The subsequent adjustment to match time of MDH loggers (GPS-time) was small, +13 seconds.

Cable stretch of transducers was on the order of 0.2 feet and could be assumed to have occurred before the start of the test because of the influence of the production (step) test on transducer position within the vent tube and the length of pre-test monitoring.

There is intimate connection between the pumped well and the nearest obwell that complicates the analysis of these data. The obwell reacted within tenths of seconds to any disturbance in the pumped well. This is assumed to result from conduits within the Prairie du Chien Group, bedding-plane fractures, and well development techniques employed by the drillers.

Transient analyses

- Theis analyses generally show the expected increase in transmissivity with radial distance from the pumped well. However, the storage coefficient calculated from transient methods (plots 1-6) of 10^{-5} is representative of a highly confined system. The leaky system that is known to exist in this area is expected to produce storativity values in the range of 10^{-4}. Also, a storativity of 10^{-5} is sufficiently isolated from precipitation events that no detectable recharge should occur as a result of infiltration. This is contradicted by pretest monitoring data, Appendix 2.

- The poor match to the Theis curve on A1-4 demonstrates 1) the enhanced efficiency of the pumped well and 2) the apparent negative efficiency in the nearby obwell. Both of these effects are removed when an identical radial distance of 20feet is used to adjust the plots, A1-5. This is a further demonstration of the interconnection of the boreholes.

- The response in the most distant obwell determines the storage coefficient on plot A1-5. In order to obtain a minimum reasonable storage coefficient of 10^{-4}, this well would have to be located ~700 feet from the pumped well, 1/3 of the actual radial distance. The magnitude of this difference in length indicates an inhomogeneity which can have a large scale effect such as; conduit flow and/or bedding-plane fractures, rather than grain-size variation or other type of depositional fabric which tend to have more local effects.

Steady-state analyses

- For the steady-state analysis, drawdown was projected to 10,000 minutes of pumping, plot A1-6. These values were used for the distance-drawdown plots, A1-7 & 8. The steady-state analyses are problematical. On A1-7, when actual radial distance is used – T is unrealistically low and the characteristic leakage factor is quite large for this setting; neither values are acceptable. Whereas on A1-8, the T is reasonable but the leakage factor is truly unreasonably large (physically impossible).

The recovery analysis, plot A1-9, produces a more reasonable transmissivity and storage coefficient that is considered representative of the aquifer properties in this area, assuming a radial distance of 20 feet. However, the characteristic leakage factor is not provided by this type of analysis.

Evaluation of Test Results

Hydraulic response affected by:

- Well construction techniques and the geological character of aquifer materials cause a very large effective radius of the pumped well;
- The connection between the pumped well and nearest obwell was such that the hydraulic response of the obwell was essentially identical to that of the pumped well, even though the radial distance between the wells was 133 feet.
- Open conduits and/or bedding-plane fractures within the dolostone - sandstone aquifer transmit pumping stresses very quickly over a wide area.
- Other pumping wells influenced water levels in later portions of test, particularly at the distant obwell.

Consistency with conceptual model:

Neither of the distance-drawdown analyses can be considered to produce reasonable results because the storage coefficient and characteristic leakage factor are representative of more highly confined systems. In a highly confined system, pumping stress is transmitted very efficiently over a wide area. In Hennepin County, this aquifer system is leaky (semi-confined). Therefore, modification of both the transient or steady-state conceptual models to incorporate fracture/conduit flow is required to accurately represent aquifer conditions within the Prairie du Chien –Jordan system.

The fact that the standard porous media conceptual models do not produce consistent results is implies a low level of confidence for predictive modeling of this aquifer system, particularly when flow models do not incorporate other flow types. Improved understanding of this flow system (fracture flow analysis) is not possible without many more wells and a great deal of testing.

Representative aquifer properties best represented by: the Agarwal recovery analysis, plot A1-9. Based on this storativity and other tests performed in this aquifer system, the characteristic leakage factor is roughly estimated to be in the range of 1000 to 3000 feet and certainly no larger.

References:

Agarwal, R.G., (1980) A new method to account for producing time effects when drawdown type curves are used to analyze pressure buildup and other test data. SPE Paper 9289, presented at the 55th SPE Annual Technical Conference and Exhibition, Dallas, Texas, September 21–24, 1980.

Cooper, H.H. and Jacob, C.E. (1946) A Generalized Graphical Method for Evaluating Formation Constants and Summarizing Well-filed History, Trans. American Geophysical Union, V. 27, pp. 526 – 534.

deGlee, G. (1930) Over grondwaterstroomingen bij wateronttrekking door middle van putten. Ph.D. thesis, Delft Technische Hogeschool, Delft.

deGlee Method [English] in:
Kruseman and De Ridder, (1991) Analysis and Evaluation of Pumping Test Data (2nd Edition), Publication 47, International Institute for Land Reclamation and Improvement, P.O. Box 45, 6700 AA Wageningen, The Netherlands, pp. 76-78.

Hantush, M. S., (1960) Modification of the Theory of Leaky Aquifers, Journal of Geophysical Research, Vol. 65, pp. 3713-25.

Theis, C. V., (1935) The Relation Between the Lowering of the Piezometric Surface and the Rate and Duration of Discharge of a Well Using Ground-Water Storage, Trans. American Geophysical Union, 16th Annual Meeting, April, 1935, pp. 519-24.

Appendix 1

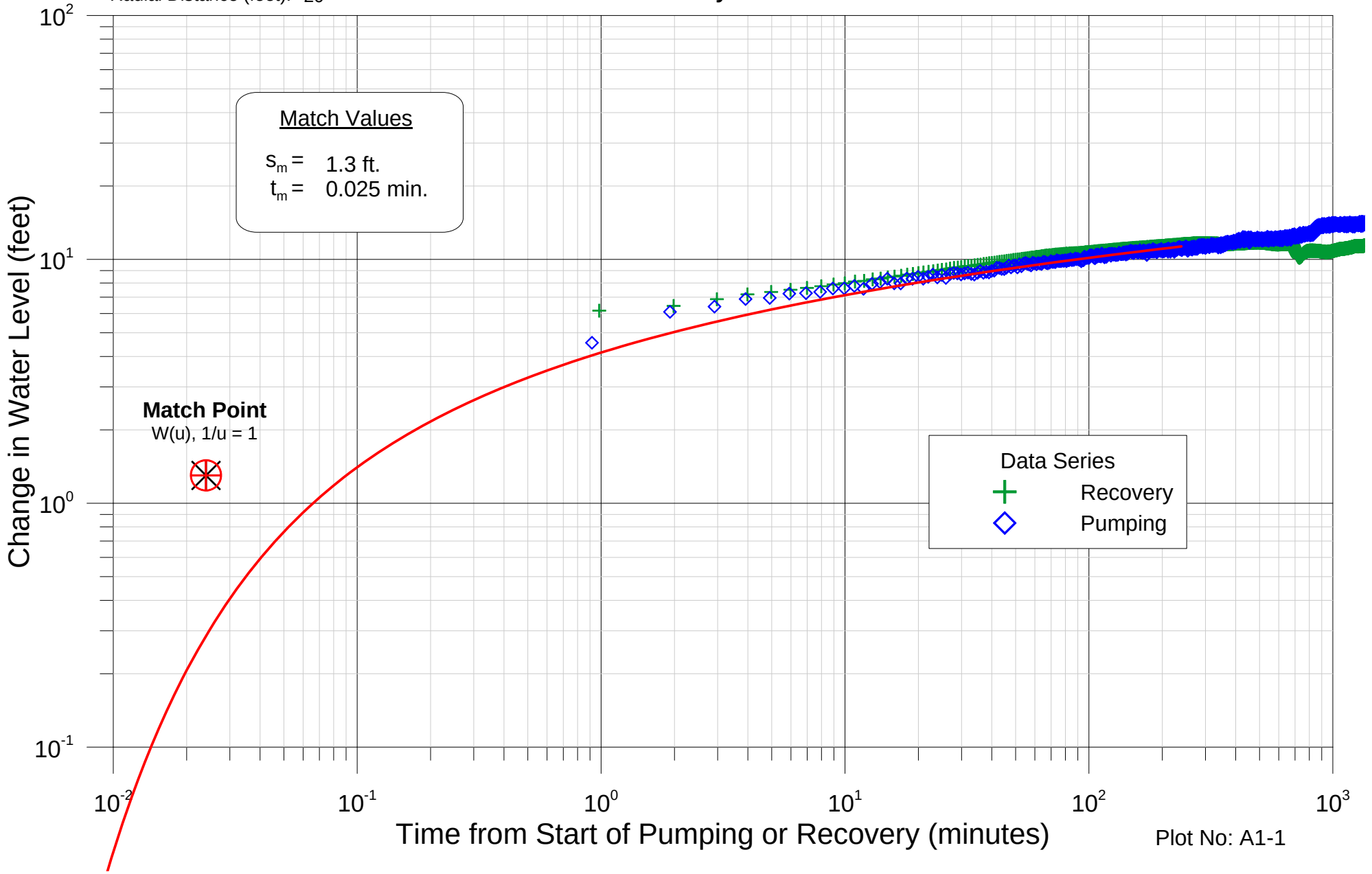
Graphical Analysis

MDH Test No: 2462
Pumped Well: GC 2 (802162)
Obwell: --
Test Date: 5/5/2014
Data Series: Composite pumping and recovery
Discharge Rate (gpm): 1100
Radial Distance (feet): 20

$T = 15.3 \bullet Q \bullet W_{(u)} / s_m$
$S = T \bullet t_m \bullet 1/u / r^2 \bullet 360$

$T = 15.3 * 1100 / 1.3 = 12946.2$ ft²/day
S = Not Applicable

Theis Analysis



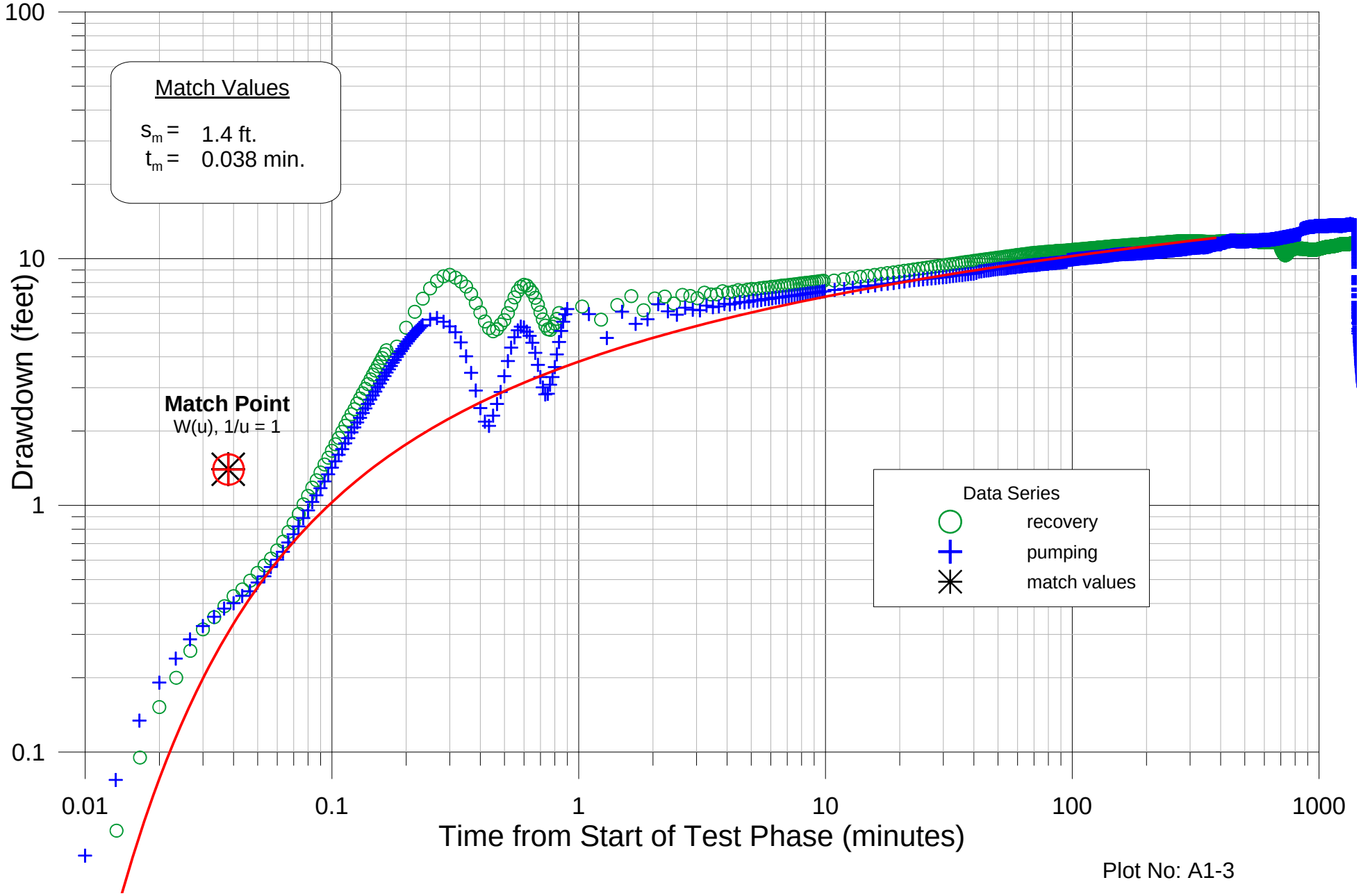
Plot No: A1-1

MDH Test No: 2462
Pumped Well: GC 2 (802162)
Obwell: GC 1 (216009)
Test Date: 5/5/2014
Data Series: Composite pumping and recovery
Discharge Rate (gpm): 1100
Radial Distance (feet): 133

$T = 15.3 \bullet Q \bullet W_{(u)} / s_m$
$S = T \bullet t_m \bullet 1/u / r^2 \bullet 360$

$T = 15.3 * 1100 / 1.4 = 12021.4\ ft^2/day$
$S = 12021.4 * 0.038 / (133^2 * 360) = 7.17355e-005$

Theis Analysis



Plot No: A1-3

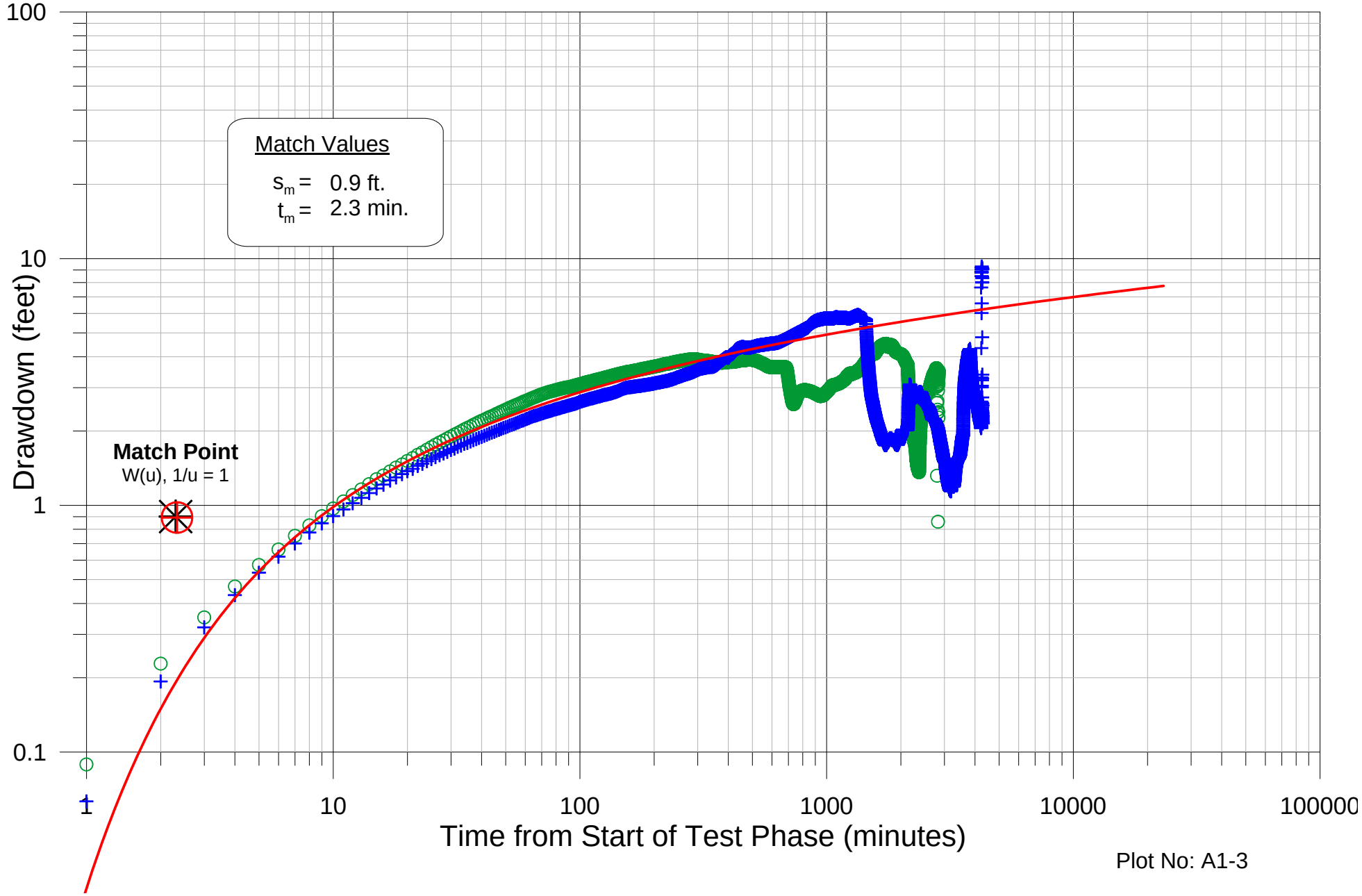
MDH Test No: 2462
Pumped Well: GC 2 (802162)
Obwell: MH (216067)
Test Date: 5/5/2014
Data Series: Composite pumping and recovery
Discharge Rate (gpm): 1100
Radial Distance (feet): 2072

Theis Analysis

$T = 15.3 \bullet Q \bullet W_{(u)} / s_m$

$S = T \bullet t_m \bullet 1/u / r^2 \bullet 360$

T = 15.3 * 1100 / 0.9 = 18700 ft²/day
S = 18700 * 2.3 / (2072^2 * 360) = 2.78283e-005



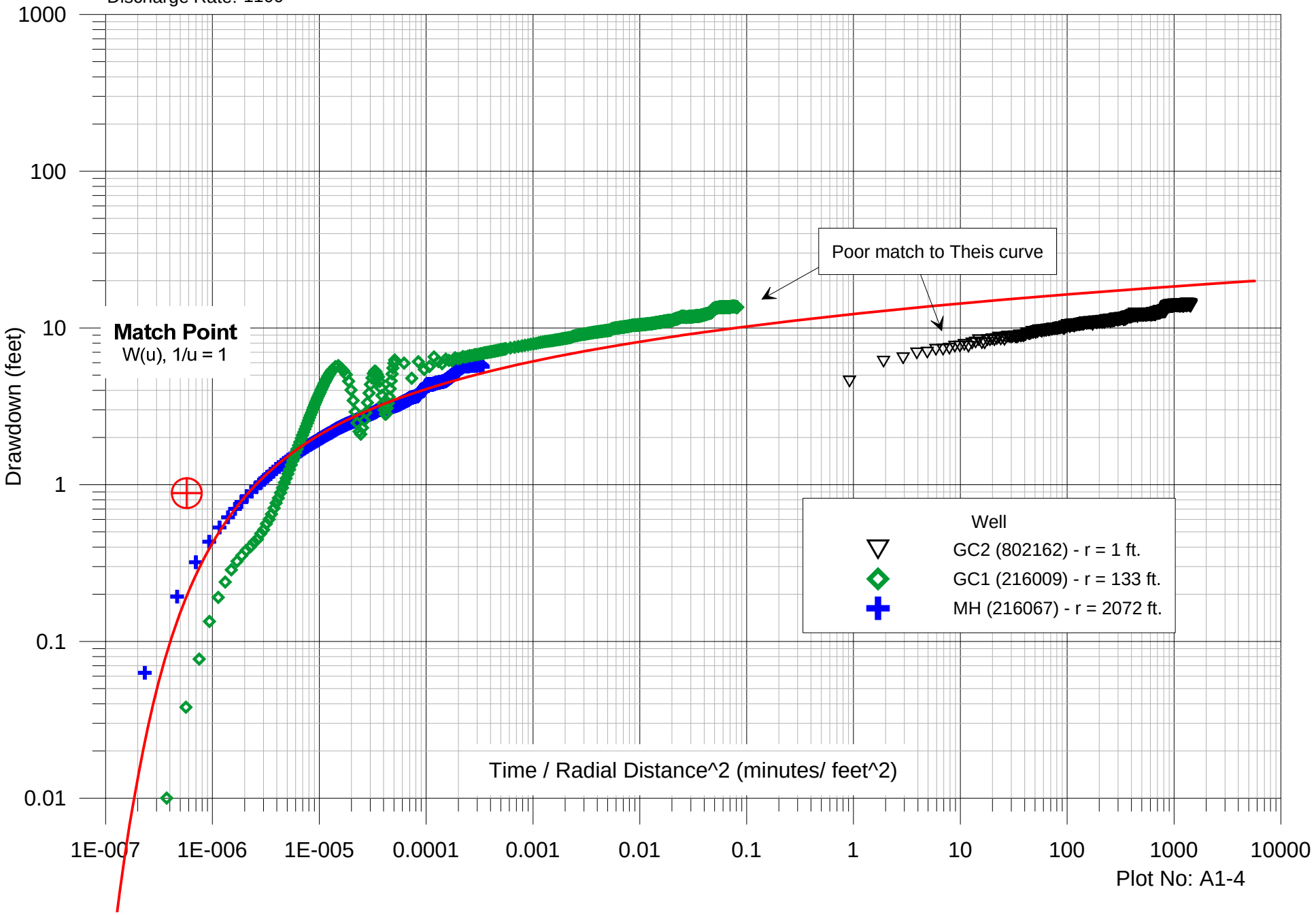
Plot No: A1-3

MDH Test No: 2462
Pumped Well: GC 2 (802162)
Test Date: 5/5/2014
Data Series: Pumping
Discharge Rate: 1100

Theis Distance-Drawdown Analysis
- actual radial distance

$T = 15.3 \bullet Q \bullet W_{(u)} / s_m$

$S = T \bullet t_m \bullet 1/u / 360$

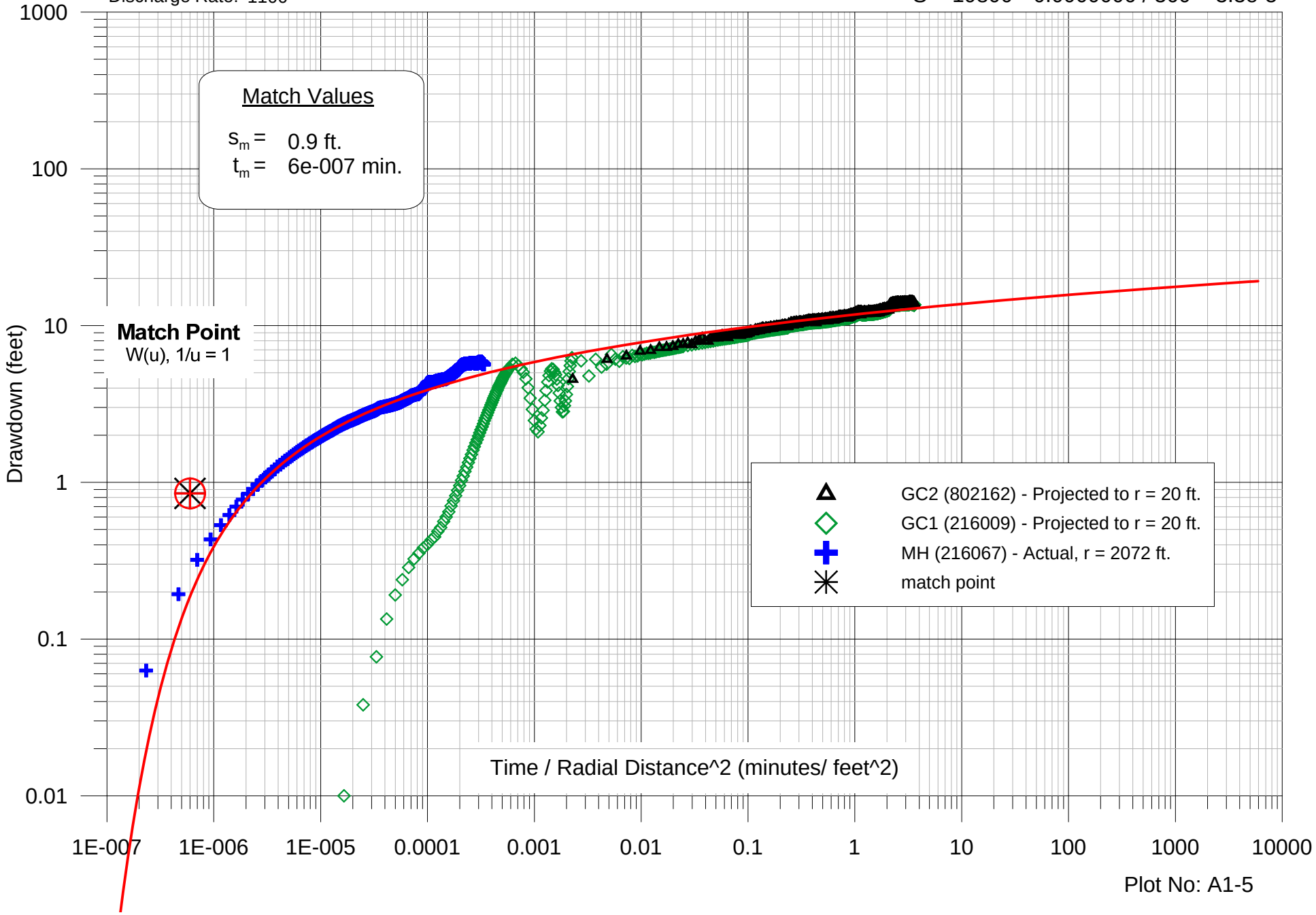


Plot No: A1-4

MDH Test No: 2462
Pumped Well: GC 2 (802162)
Test Date: 5/5/2014
Data Series: Pumping
Discharge Rate: 1100

Theis Distance-Drawdown Analysis
Projected to r = 20 ft.

$T = 15.3 \bullet Q \bullet W_{(u)} / s_m$
$S = T \bullet t_m \bullet 1/u / 360$
$T = 15.3 * 1100 / 0.9 = 19800\ ft^2/day$
$S = 19800 * 0.0000006 / 360 = 3.3e\text{-}5$



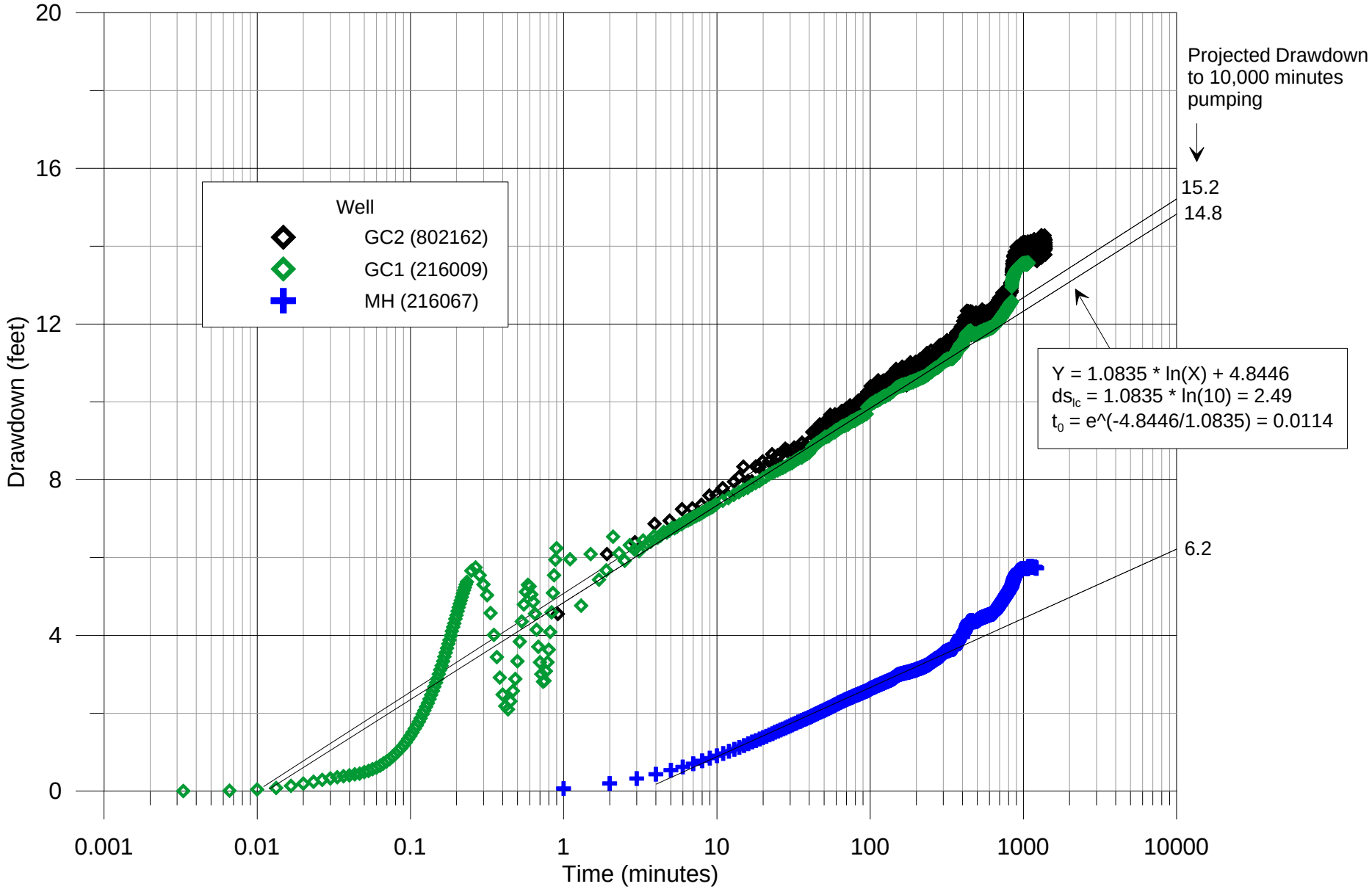
Plot No: A1-5

MDH Test No: 2462
Pumped Well: GC 2 (802162)
Test Date: 5/5/2014
Data Series: Pumping
Discharge Rate: 1100 gpm

$T = (2.303 * 1440 / 7.48 / 4 / pi()) * Q / ds'_{lc}$
$S = T * t_0 / (r^2 * 640)$

$T = 35.3 * 1100 / 2.49 = 15600\ ft^2/day$
$S = 15600 * 0.01143 / (133^{\wedge 2} * 640) = 1.6e\text{-}5$

Cooper-Jacob Analysis

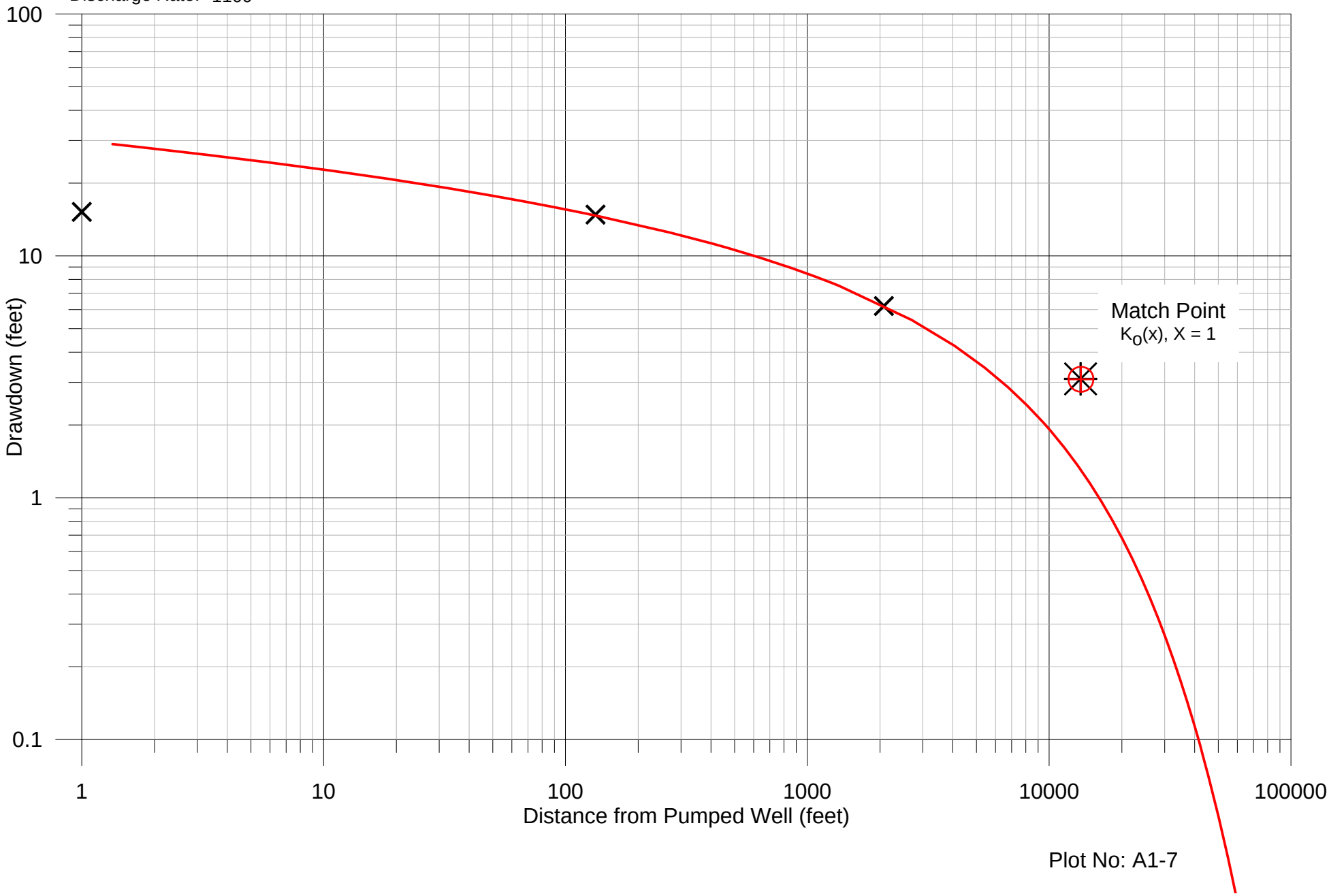


Plot No: A1-6

MDH Test No: 2462
Pumped Well: GC 2 (802162)
Test Date: 5/5/2014
Data Series: Pumping
Discharge Rate: 1100

de Glee Analysis
projected pumping to 10,000 minutes

T = 30.6 1100 / 3.1 = 10858.1 ft^2/day
L = 13500
c = (13500^2/10858.1) = 16784.8 days

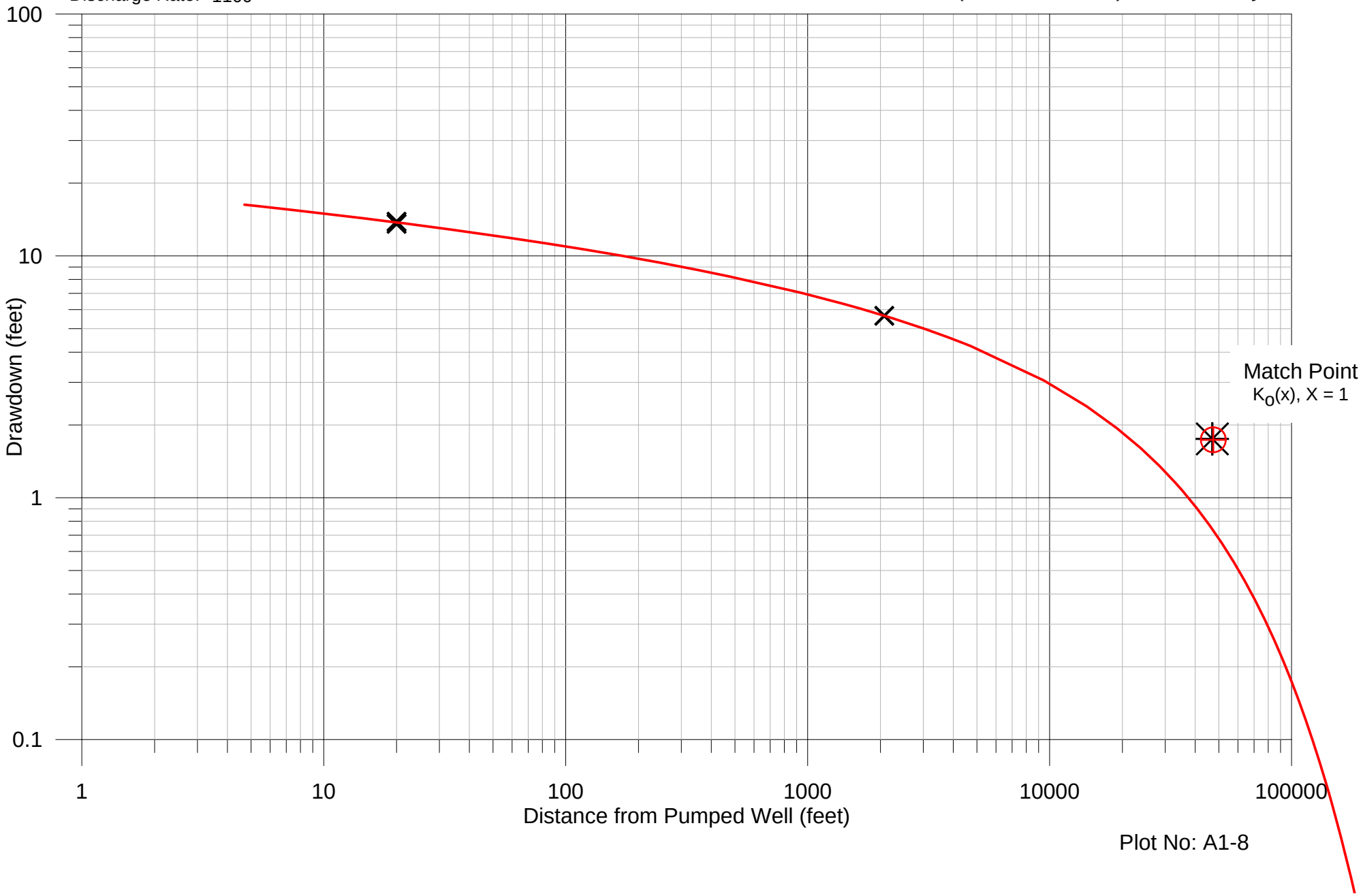


Plot No: A1-7

MDH Test No: 2462
Pumped Well: GC 2 (802162)
Test Date: 5/5/2014
Data Series: Pumping
Discharge Rate: 1100

de Glee Analysis
adjusted radial distance and
projected pumping to 10,000 minutes

T = 30.6 1100 / 1.75 = 19234.3 ft^2/day
L = 47000
c = (47000^2/19234.3) = 114847 days

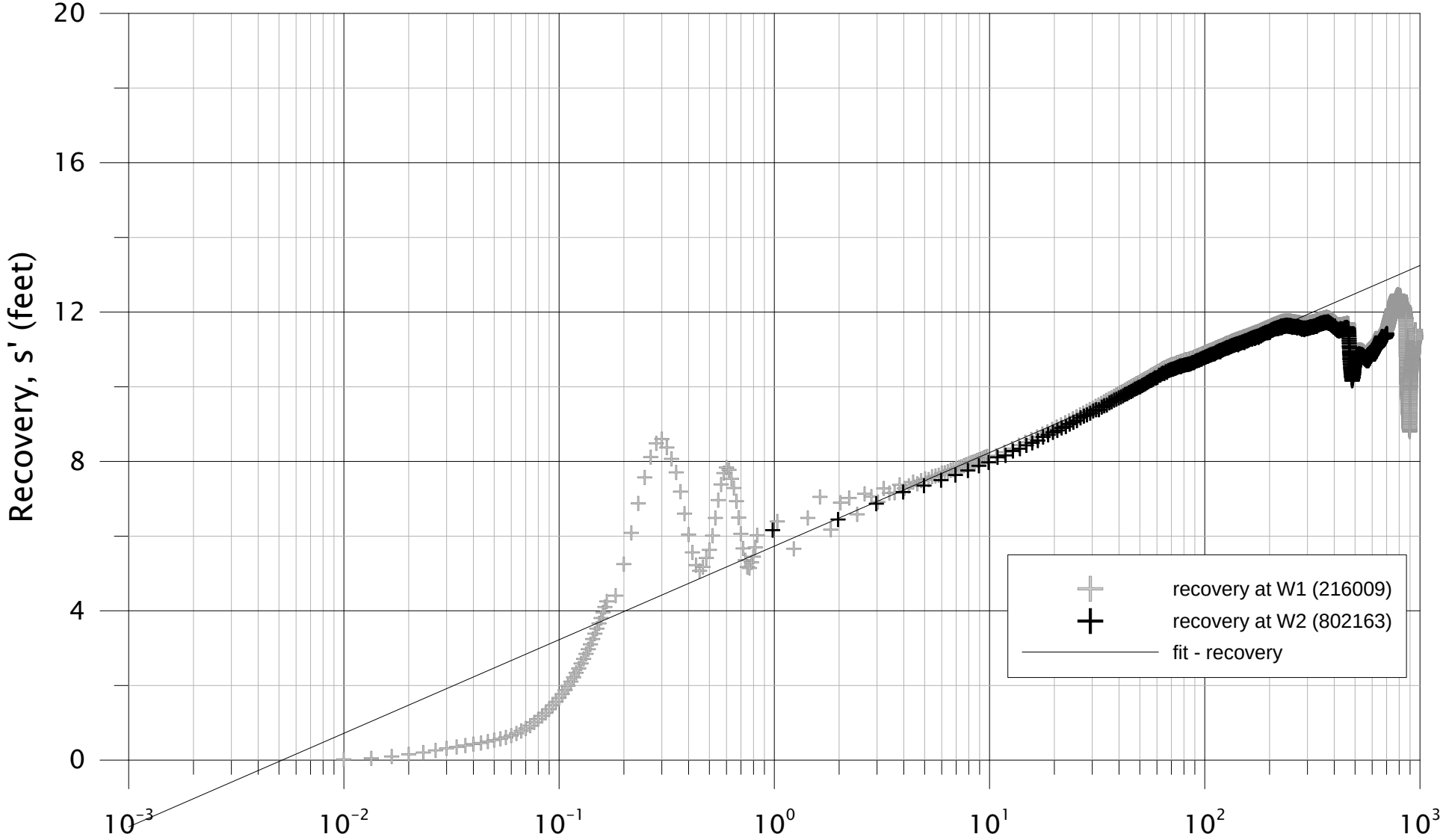


Plot No: A1-8

Q = 1100 gpm
Fit = 1.0884 * ln(X) + 5.7296
ds'_{lc} = 1.0884 * ln(10) = 2.51
t_0 = e^(-5.7296/1.0884) = 0.00517

Test of Meadowbrook 2 (802162)
05/05/2014
Recovery

$T = (2.303 * 1440 / 7.48 / 4 / pi()) * Q / ds'_{lc}$
$S = 2.25 * T * t_0 / (r^2 * 1440)$
$T = 35.3 * 1100 / 2.51 = 15470\ ft^2/day$
$S = 2.25 * 15470 * 0.00517 / (20^2 * 1440) = 3.1e-4$



Agarwal Equivlalent Time

t_p=pumping time (fixed), t'=elapsed recovery time

$(t_p * t') / (t_p + t')$

Plot No: A1-9

Appendix 2

Documentation

MINNESOTA MDH DEPARTMENT of HEALTH
Source Water Protection Unit
Drinking Water Protection Section
P.O. Box 64975
St. Paul, Minnesota 55164-097

Test No. **2462**

Aquifer Test Information

A – Test Information		
Test Location **Meadowbrook Golf Course 2**	Well Owner **Minneapolis Park Board**	Test Conducted By **Traut Well Drilling / MDH**
Aquifer **Prairie du Chien-Jordan**	Confined/Unconfined **confined**	Flow Rate (Units) **1100 gpm**
Date/Time - Monitoring Start **04/18/2014 12:51:06**	Pump Type **submersible**	Flow Rate Measuring Device **turbine**
Date/Time - Test Start **05/05/2014 09:30:05**	Drop Pipe Length (Pump Intake)	Totalizer: End **68535050**
Date/Time - Recovery Start **05/06/2014 09:35:01**	Pumped Well Inner Casing Diameter	Totalizer: - Start **66926450**
Date/Time - Test Finish **05/08/2014 09:10**	Pump Pre-lube Time: **NA**	= Total Pumped (Units) **1608600**

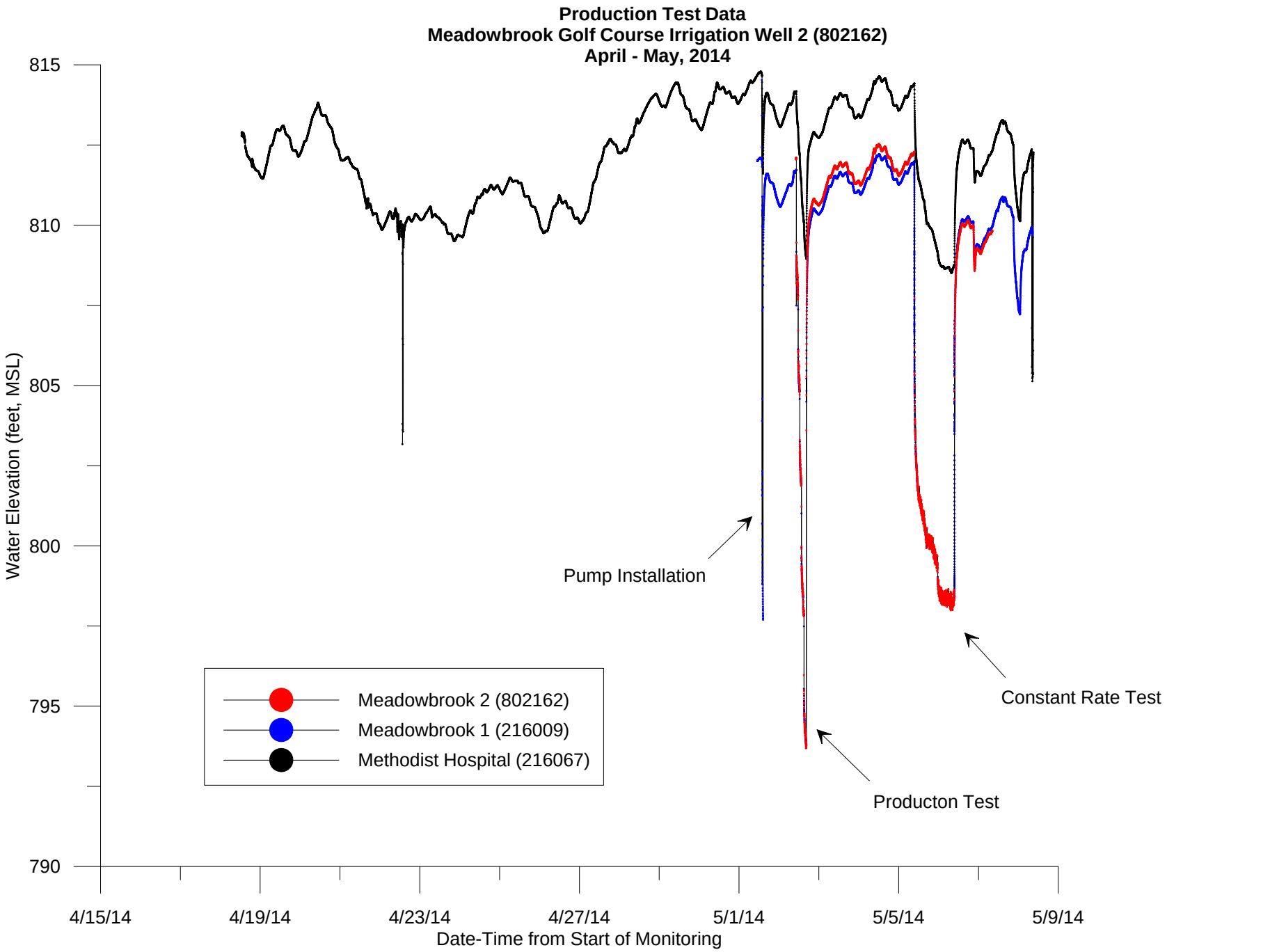
B – Well Information

Well Name (Unique Number)	Location		Radial Distance (feet)	Ground Surface Elevation (ft.) GSE	Measuring Point Desc. GSE + (stick-up)	Open Interval (feet, MSL)	Aquifer
	Easting (m)	Northing (m)					
Meadowbrook GC 2 **(802162)**	417218	4974638	~20	894.5	+ 3.27 ft. Vent Tube	from 634 to 380	Prairie du Chien - Jordan
Meadowbrook GC 1 **(216009)**	417229	4974599	133	893.6	+~ 1 ft. Vent Tube	from 582 to 337	Prairie du Chien –St. Lawrence
Methodist Hospital **(216067)**	417392	4975245	2072	891.1	+~ 2 ft. Vent Tube	from 636 to 406	Prairie du Chien - Jordan
						from to	
						from to	

C – Data Collection

Data File Name: Well Name_Unique Number	Data Logger Type, SN:	Probe Id., Range (psi)	Installation		Removal		Difference	
			Static WL	Transducer Setting	Static WL	Transducer Setting	Static WL	XD Setting
GC2_802162.xslx	Traut in-situ troll	SN:118832 100 psi	82	181.8				
GC1_216009.xlsx	MDH box 3 Hermit 1K	9 - 30 psi	84.60	-55.72	87.00	XD_r -53.85 XD_o -53.52	2.40	2.20
MH_216067.xslx	MDH box 5 Hermit 3K	4 - 20 psi	81.33	-19.57	81.15	XD_r -19.81 XD_o -same	-0.17	0.24

Test Notes: 150 to 200 yd^3 blasted & bailed from well during development. GSE from Lidar +1 ft. to account for fill at wellhead for drilling platform.


Production Test Data
Meadowbrook Golf Course Irrigation Well 2 (802162)
April - May, 2014
Water Elevation (feet, MSL)
815
810
805
800
795
790
4/15/14
4/19/14
4/23/14
4/27/14
5/1/14
5/5/14
5/9/14
Date-Time from Start of Monitoring
Meadowbrook 2 (802162)
Meadowbrook 1 (216009)
Methodist Hospital (216067)
Pump Installation
Constant Rate Test
Producton Test
MDH, May - 2014

STEP TEST

PROJECT: MEADOWBROOK GOLF COURSE Well # N/A Uniq # 802162

Test By: BRIAN TRAUT Job # 3010588

Meter Reading Beginning: _____

Meter Reading Ending: _____

Well Information: Transducer set at: _____ ft. (From Grade)

Length of Casing: _____

Length of Screen: _____ Hp of Pump: _____

Total Well Depth: _____ Model of Pump: _____

Static Water Level: _____ ft (From Grade)

Well Capacity: _____ GPM @ _____ PWL _____ **G.P.F.D.D.**

Date	Time	AM	PM	GPM	PWL	Sand/Gal	COMMENTS
1/2/2001	12:34	X	X	123	12'3"	4" c/g	This is a sample
5/2/2014	2:45		X	1400	96.47	clear/few grains	
	3:01		X		96.73		
	3:03		X	1700		clear	
	3:07		X		99.47	1/32" c/g clear	
	3:17		X		99.84		
	3:48		X		100.48		
	4:30		X	1700	100.87	1/32" c/g clear	
	4:31		X	SHUT DOWN			
	4:34		X		89.02		
	4:42		X		87.20		
	4:57		X		85.97		

The data stated above is representative of the time spent pumping at the capacities stated. Deviation from either time spent pumping or both could change the outcome if these results.

NOTE: On RECOVERY need: 5-1 minute checks 2-30 minute checks

5-5 minute checks 1-per hour as needed

Notes:

STEP TEST

PROJECT: MEADOWBROOK GOLF COURSE Well # N/A Uniq # 802162

Test By: BRIAN TRAUT Job # 3010588

Meter Reading Beginning: 66504500

Meter Reading Ending: 66926500

Well Information: Transducer set at: 181.8 ft. (From Grade)

Length of Casing: 260' from grade

Length of Screen: N/A Hp of Pump: 150

Total Well Depth: 465' Model of Pump: AMERICAN MARSH

Static Water Level: 82.2' ft (From Grade)

Well Capacity: 1700 GPM @ 101 PWL 89 **G.P.F.D.D.**

Date	Time	AM	PM	GPM	PWL	Sand/Gal	COMMENTS
1/2/2001	12:34	X	X	123	12'3"	4" c/g	This is a sample
5/2/2014	9:49	X					
	10:30	X		500			
	10:36	X				clear/few grains	
	10:40	X			85.35		
	10:54	X			85.65		
	11:00	X			85.85		
	11:15	X			86.00		
	11:30	X		800	88.70	clear/few grains	
	11:41	X			89.08		
	12:29		X		89.61		
	12:31		X	1100			
	12:35		X		91.46	clear/few grains	
	12:40		X		91.69		
	1:00		X		92.14		
	1:16		X		92.59		
	1:29		X		92.45		
	1:31		X	1400			
	1:35		X		94.96	clear/few grains	
	1:47		X		95.62		
	2:09		X		95.80		
	2:12		X		95.00		
	2:24		X		95.99		
	2:31		X		95.98		
	2:36		X		96.04		

The data stated above is representative of the time spent pumping at the capacities stated. Deviation from either time spent pumping or both could change the outcome if these results.

NOTE: On RECOVERY need: 5-1 minute checks 2-30 minute checks

5-5 minute checks 1-per hour as needed

Notes:

24-HR TEST PUMP

PROJECT: MEADOWBROOK GOLF COURSE Well # N/A Uniq # 802162

Test By: BRIAN TRAUT Job # 3010588

Meter Reading Beginning: 66926500

Meter Reading Ending: 68535000

Well Information: Transducer set at: 181.8 ft. (From Grade)

Length of Casing: 260'

Length of Screen: N/A Hp of Pump: 150

Total Well Depth: 465 Model of Pump: AMERICAN MARSH

Static Water Level: 82' (From Grade)

Well Capacity: 1100 GPM @ 90.34 PWL 76.55 **G.P.F.D.D.**

Date	Time	AM	PM	GPM	PWL	Sand/Gal	COMMENTS
1/2/2001	12:34	X	X	123	12'3"	4" c/g	This is a sample
5/5/2014	9:00	X					
	9:30	X		1100			
	9:32	X			88.78	clear, few grains fo sand	
	9:40	X			90.04		
	10:10	X					
	10:17	X			91.58		
	11:06	X			92.36		
	3:22		X		93.81		
	11:30		X		95.33		
5/6/2014	8:36	X		1100	96.27		
	9:35	X		SHUT DOWN			
	9:36	X			90.34		
	9:45	X			87.90		

The data stated above is representative of the time spent pumping at the capacities stated. Deviation from either time spent pumping or both could change the outcome if these results.

NOTE: On RECOVERY need: 5-1 minute checks 2-30 minute checks

5-5 minute checks 1-per hour as needed

Notes:

Minnesota Unique Well No.

802162

County Hennepin
Quad Minneapolis South
Quad ID 104A

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 103I

Entry Date 03/26/2014
Update Date 04/21/2014
Received Date

Well Name MEADOWBROOK GOLF COURSE

Township	Range	Dir	Section	Subsections	Elevation
117	21	W	20	DACCAD	893.5 ft.

Elevation Method LiDAR 1m DEM (MNDNR)

Well Depth	Depth Completed	Date Well Completed
465 ft.	465 ft.	

Drilling Method --

Drilling Fluid --

Well Hydrofractured? ☐ Yes ☐ No From Ft. to Ft.

Use Irrigation

Casing Type Steel (black or low carbon) **Joint** Welded **Drive Shoe?** ☐ Yes ☐ No **Above/Below** ft.

Casing Diameter	Weight	Hole Diameter
18 in. to ft.	lbs./ft.	
24 in. to ft.	lbs./ft.	

Open Hole from ft. to ft.

Screen NO **Make** **Type**

Diameter	Slot/Gauze	Length	Set Between

Static Water Level
104 ft. from Land surface Date Measured 04/01/2014

PUMPING LEVEL (below land surface)
ft. after hrs. pumping g.p.m.

Well Head Completion
Pitless adapter manufacturer Model
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

Geological Material	Color	Hardness	From	To

REMARKS

GAMMA, CALIPER, & MULTI TOOL LOGGED 4-1-2014. M.G.S. NO. 5385.
LOGGED FOR COUNTY ATLAS.
0-71 QUUU, 71-81 OPVL, 81-87 OGWD, 87-253 OSTP, 253-375 OPDC, 375-469 CJDN.

Grouting Information Well Grouted? ☐ Yes ☐ No

Located by: Minnesota Geological Survey **Method:** Digitization (Screen) - Map (1:24,000)

Unique Number Verification: Information from owner **Input Date:** 04/02/2014

System: *UTM - Nad83, Zone15, Meters* **X:** 471218 **Y:** 4974638

Nearest Known Source of Contamination
_feet _direction _type
Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed
Manufacturer's name Model number __ HP _ Volts
Length of drop Pipe _ft. Capacity _g.p.m Type Material

Abandoned Wells Does property have any not in use and not sealed well(s)? ☐ Yes ☐ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☐ No

Cuttings Yes **Borehole Geophysics** Yes

First Bedrock

Last Strat

Aquifer

Depth to Bedrock ft.

Well Contractor Certification

Mark J Traut Wells, Inc.	1404	BRIAN/JOSH
License Business Name	Lic. Or Reg. No.	Name of Driller

County Well Index Online Report

802162

Printed 5/7/2014
HE-01205-07

Unique Well Number 216009

County Hennepin
Quad Minneapolis South
Quad Id 104A

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
MINNESOTA STATUTES CHAPTER 1031

Entry Date 1991/08/24
Update Date 2014/03/26
Received Date

Well Name MEADOWBROOK GOLF COURSE

Township	Range	Dir	Section	Subsection	Field Located	
117	21	W	20	DACCDD	MGS	

Elevation 890.00 ft.

Well Depth 502.00 ft
Depth Completed 502.00 ft
Date Well Completed 1935/06/27

Well and Contact Address MEADOWBROOK GOLF COURSE

ST LOUIS PARK MN Changed

Drillhole Angle

Drilling Method Cable Tool

Drilling Fluid

Well Hydrofractured? ☐ YES ☐ NO
From ft. to

Use Public Supply/non-community

Casing Type Steel (black or low Drive Shoe? ☐ YES ☐ NO
Diameter 12 Depth 257
16.00 in. from 0.00 to 77.00 ft. lbs/ft
12.00 in. from 77.00 to 257.00 ft. lbs/ft

Hole Diameter (in.) 12.0(To 502.0

Description	Color	Hardness	From	To (ft.)
COARSE SAND & GRAVEL			0	74
LIMEROCK			74	82
SHALE			82	90
SANDROCK			90	92
SANDROCK			92	190
SHALE	RED		190	200
SANDROCK			200	252
SHAKOPEE DOLOMITE			252	253
SHAKOPEE DOLOMITE			253	375
SANDROCK			375	376
SANDROCK			376	440
SANDROCK & SHALE			440	465
SHALE	GRAY		465	502

Screen No
Make Type
Diamter Slot Length Set

Open Hole(ft.) From 257.0 to 502.0

Static Water Level
55.00 ft. Land surface Date measured 1935/06/27

Pumping Level (below land surface)
ft. after hrs. pumping g.p.m.

Wellhead Completion
Pitless adapter manufacturer Model
☐ Casing Protection ☐ 12 in. above grade
☐ At-grate (Environmental Wells and Borings ONLY) ☐ Basement offset

Grouting Information Well grouted? ☐ YES ☐ NO

Nearest Known Source of Contamination
feet Direction Type
Well disinfected upon completion? ☐ YES ☐ NO

Pump
☐ Not Installed Date Installed
Manufacture's name
Model number HP 0.00 Volts
Length of drop pipe Material Capacity g.p.m
Type

Abandoned Wells
Does property have any not in use and not sealed well(s)? ☐ YES ☐ NO

Variance
Was a variance granted from the MDH for this well? ☐ YES ☐ NO

Well Contractor Cerfication
Minnesota Geological Survey MGS

License Business Name **Lic. or Reg No.**

Remarks
GAMMA LOGGED 1-13-05 BY JIM TRAEN

First Bedrock OPVL
Last Strat CSTL
Aquifer Multiple
Depth to Bedrock 74.00 ft.

Name of Driller **Date**

Unique Well Number 216067

County Hennepin
Quad Minneapolis South
Quad Id 104A

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
MINNESOTA STATUTES CHAPTER 1031

Entry Date 1991/08/24
Update Date 2014/04/14
Received Date

Well Name METHODIST HOSPITAL

Township	Range	Dir	Section	Subsection	Field Located	MGS
117	21	W	20	ADACAD	Elevation	890.00 ft.

Well and Contact Address METHODIST HOSPITAL

ST LOUIS PARK MN Changed

Description	Color	Hardness	From	To (ft.)
DRIFT			0	85
PLATTEVILLE LIMESTONE			85	94
ST. PETER SANDSTONE			94	257
PRAIRIE DU CHIEN			257	262
PRAIRIE DU CHIEN			262	368
PRAIRIE DU CHIEN			368	377
JORDAN FORMATION			377	466
ST. LAWRENCE FORMATION			466	485

Remarks

U.S.G.S. W-48 U.S.G.S. W-48 OLD P.A. 66-5517 127104A 1172120ADACA GAMMA LOGGED & TV 2-11-1989.

First Bedrock OSTP
Last Strat CSTL
Aquifer Multiple
Depth to Bedrock 94.00 ft.

Well Depth 485.00 ft
Depth Completed 485.00 ft
Date Well Completed

Drillhole Angle

Drilling Method

Drilling Fluid

Well Hydrofractured? ☐ YES ☐ NO
From ft. to

Use Public Supply/non-community

Casing Type
Drive Shoe? ☐ YES ☐ NO
Diameter 20
Depth 255
20.00 in. from 0.00 to 255.00 ft. lbs/ft

Hole Diameter (in.)

Screen No
Make
Type
Diamter Slot Length Set

Open Hole(ft.) From 255.0 to 485.0

Static Water Level
69.00 ft. Land surface Date measured 1978/06/12

Pumping Level (below land surface)
ft. after hrs. pumping g.p.m.

Wellhead Completion
Pitless adapter manufacturer Model
☐ Casing Protection ☐ 12 in. above grade
☐ At-grate (Environmental Wells and Borings ONLY) ☐ Basement offset

Grouting Information Well grouted? ☐ YES ☐ NO

Nearest Known Source of Contamination
feet Direction Type
Well disinfected upon completion? ☐ YES ☐ NO

Pump
☐ Not Installed Date Installed
Manufacture's name
Model number HP 0.00 Volts
Length of drop pipe Material Capacity g.p.m
Type

Abandoned Wells
Does property have any not in use and not sealed well(s)? ☐ YES ☐ NO

Variance
Was a variance granted from the MDH for this well? ☐ YES ☐ NO

Well Contractor Cerfication
Mccarthy Well Co. 27022
License Business Name Lic. or Reg No.

Name of Driller Date